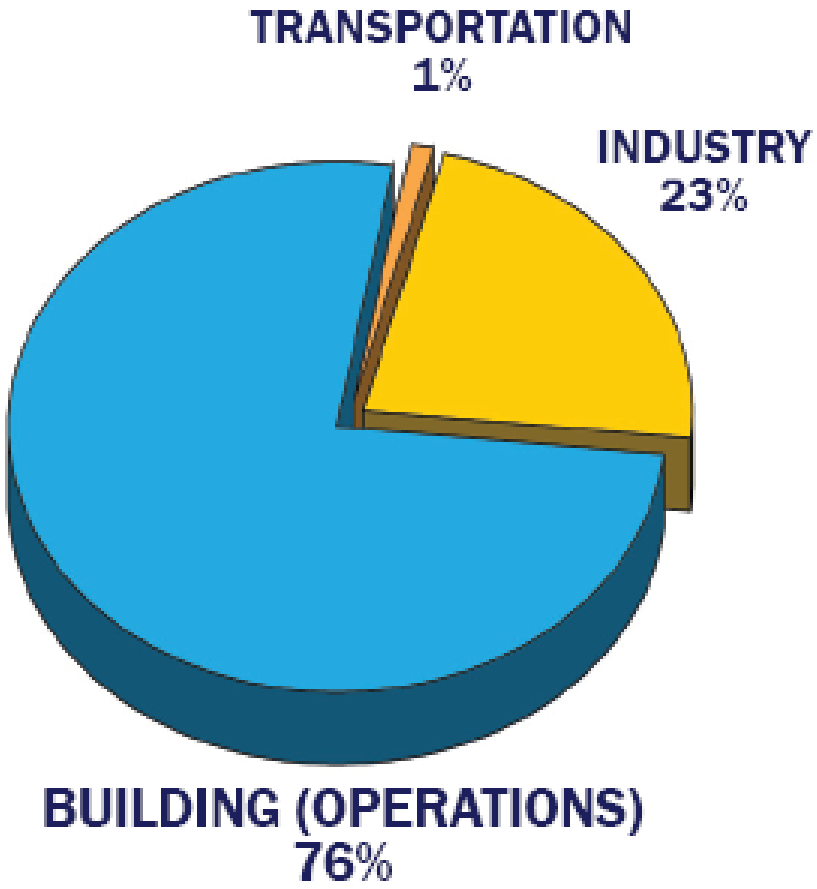
Mixed Humid Climate Region

Example Performance Targets and Efficiency Packages Greensburg, Kansas

Dr. Ren Anderson, NREL

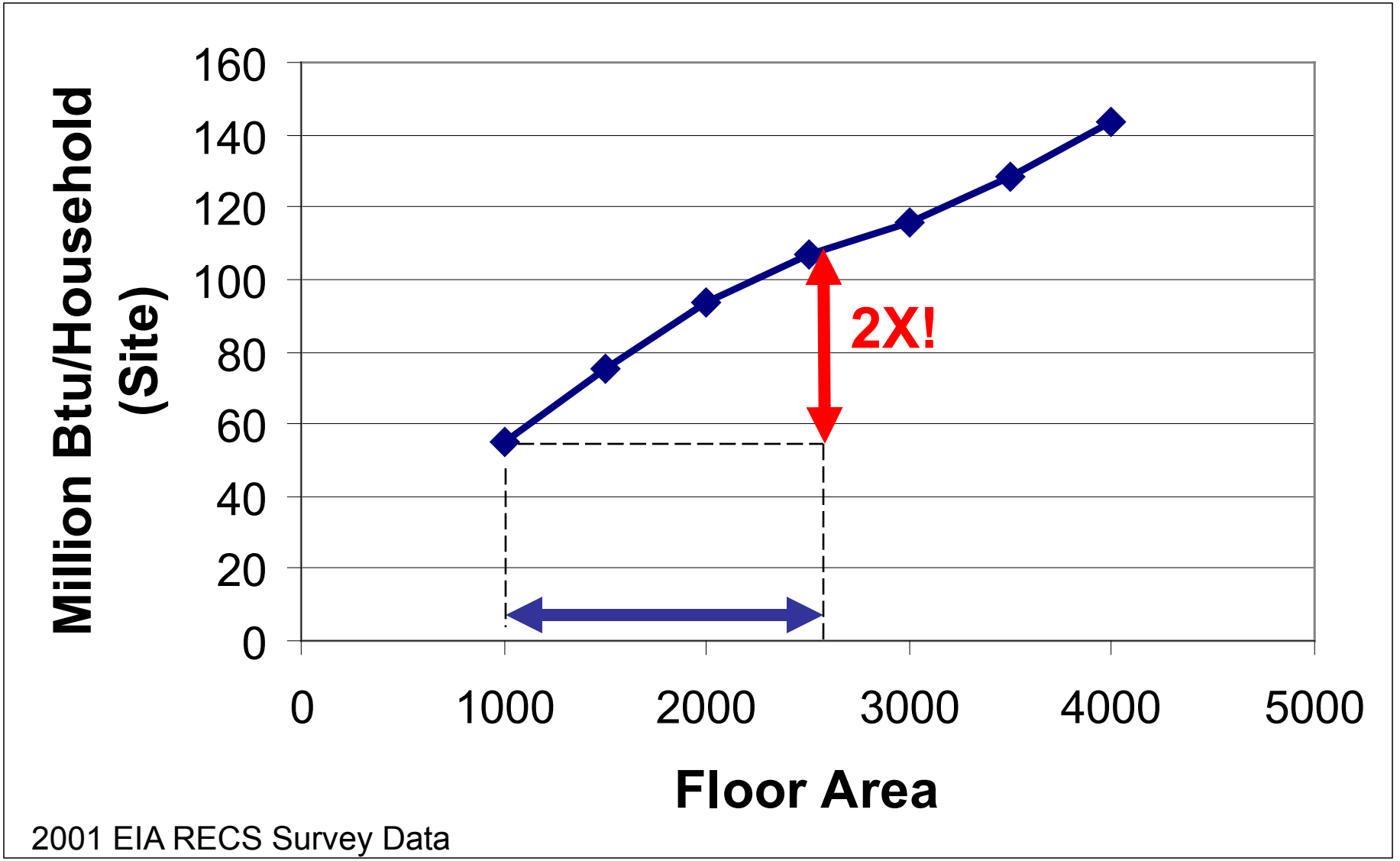
NREL/PR-550-43944
A Stand-Alone Briefing Package

Coal produces about half of the energy supplied by the Electric Power Sector, it is responsible for 81% of this sector's CO_2 emissions.



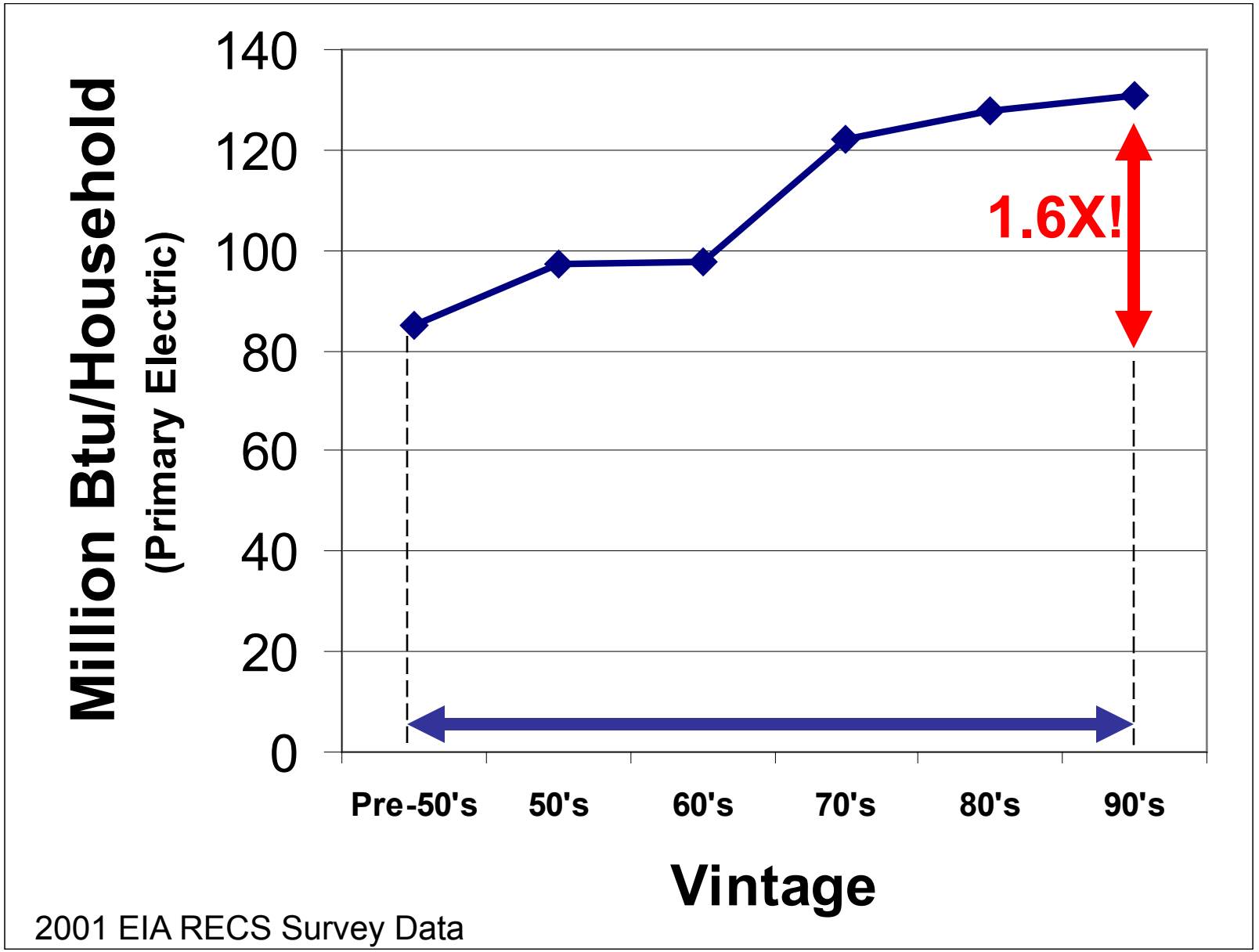
U.S. ELECTRICITY CONSUMPTION

Size Matters: 2001 RECS Site Energy Consumption Data



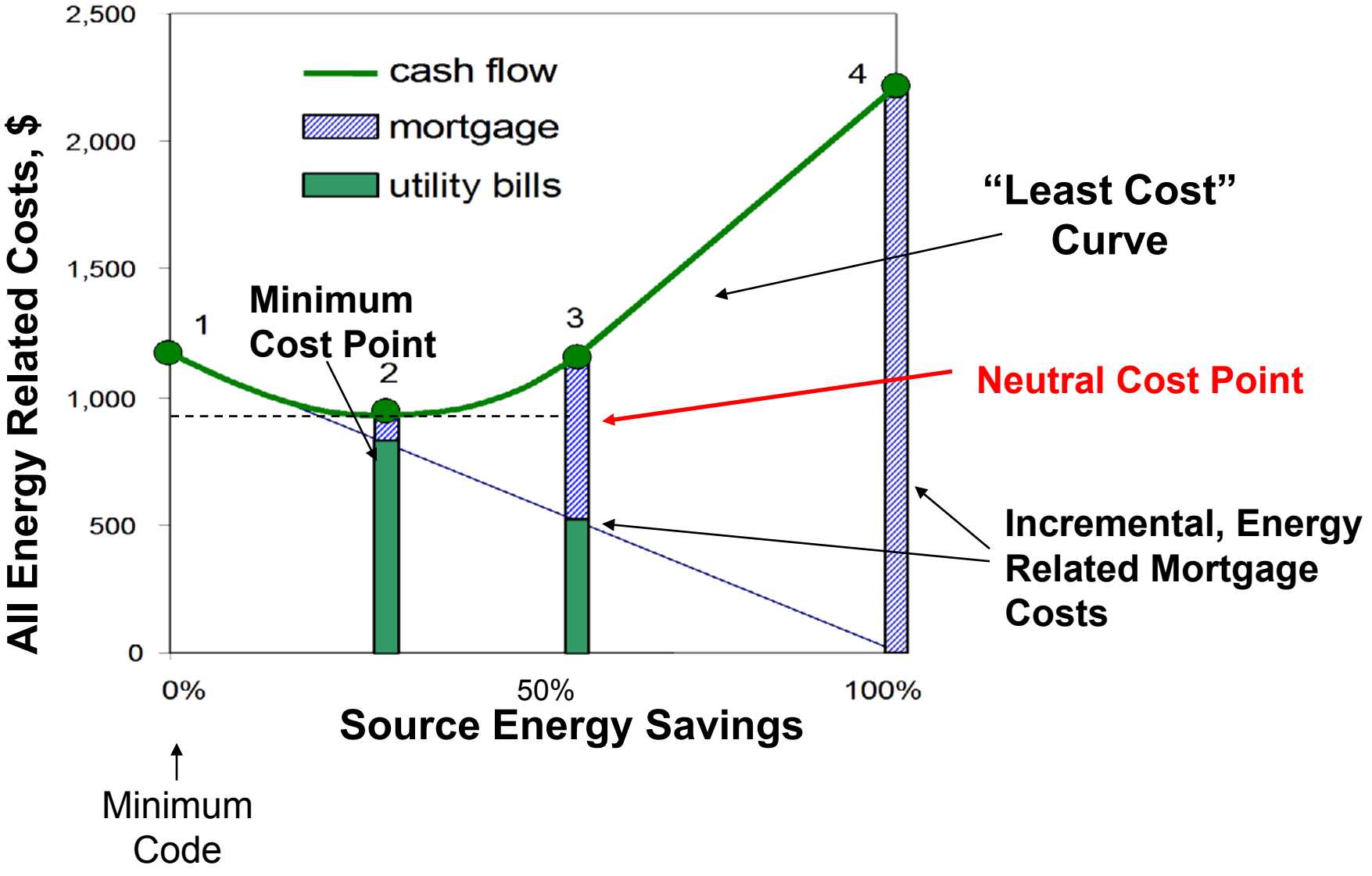
2001 EIA RECS Survey Data

Vintage Matters: 2001 RECS Primary Electric Data



2001 EIA RECS Survey Data

Home Energy Related Costs

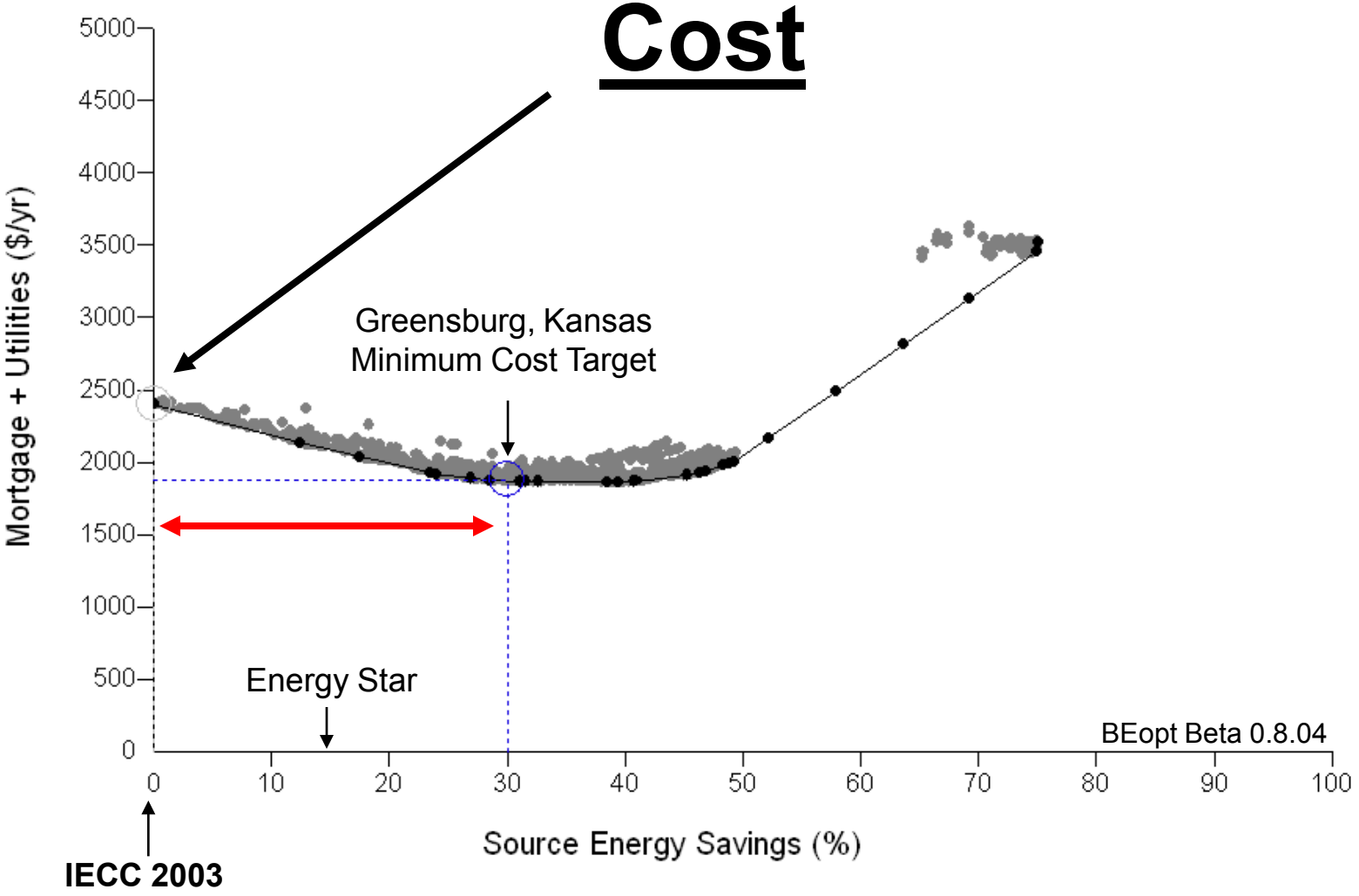


Specific Example: 2000ft2 New Home

2000 ft2, 16% window to floor area ratio

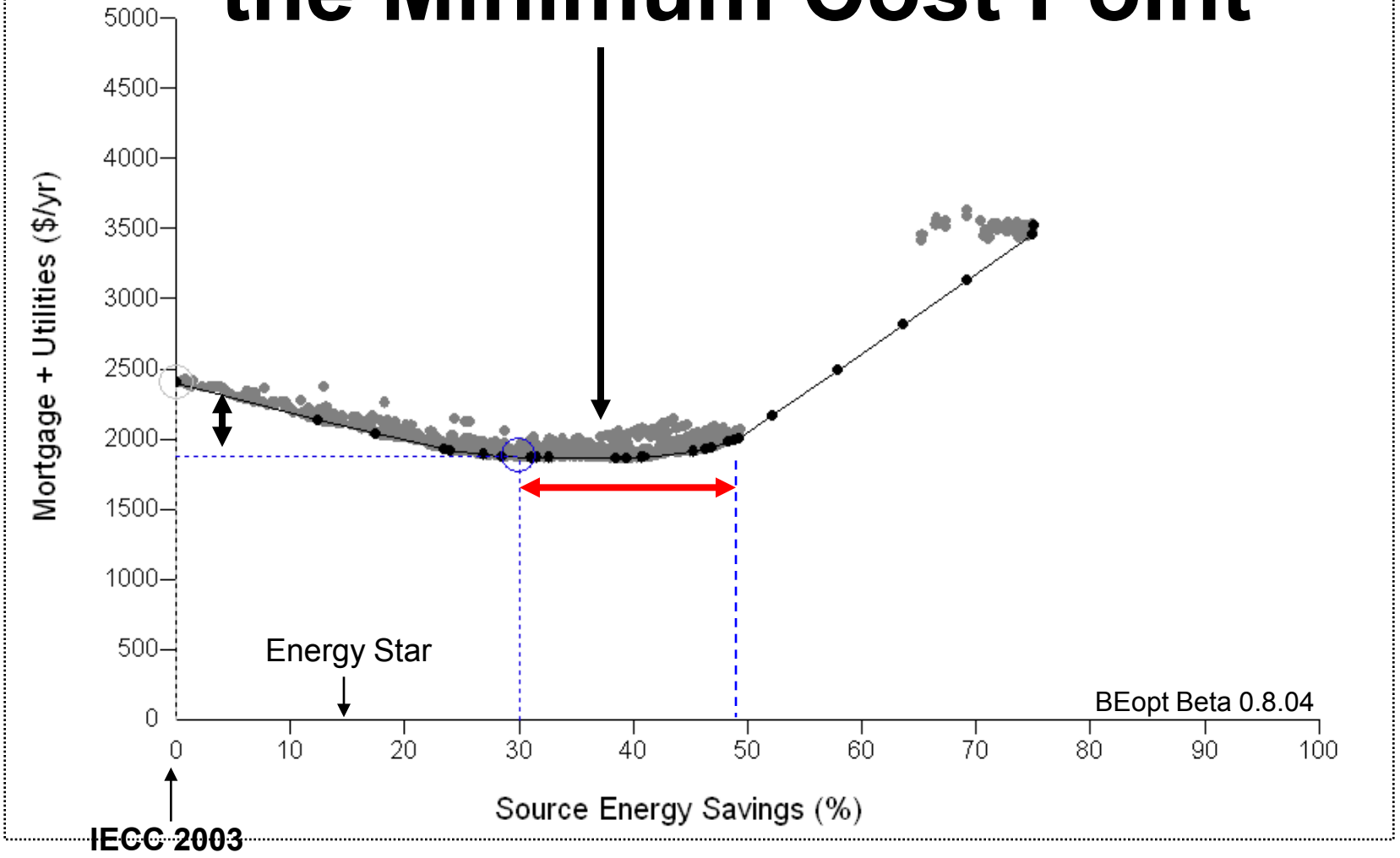
Design: Building Science Corporation

Key Finding: Current Energy Codes Do Not Achieve Minimum Cost



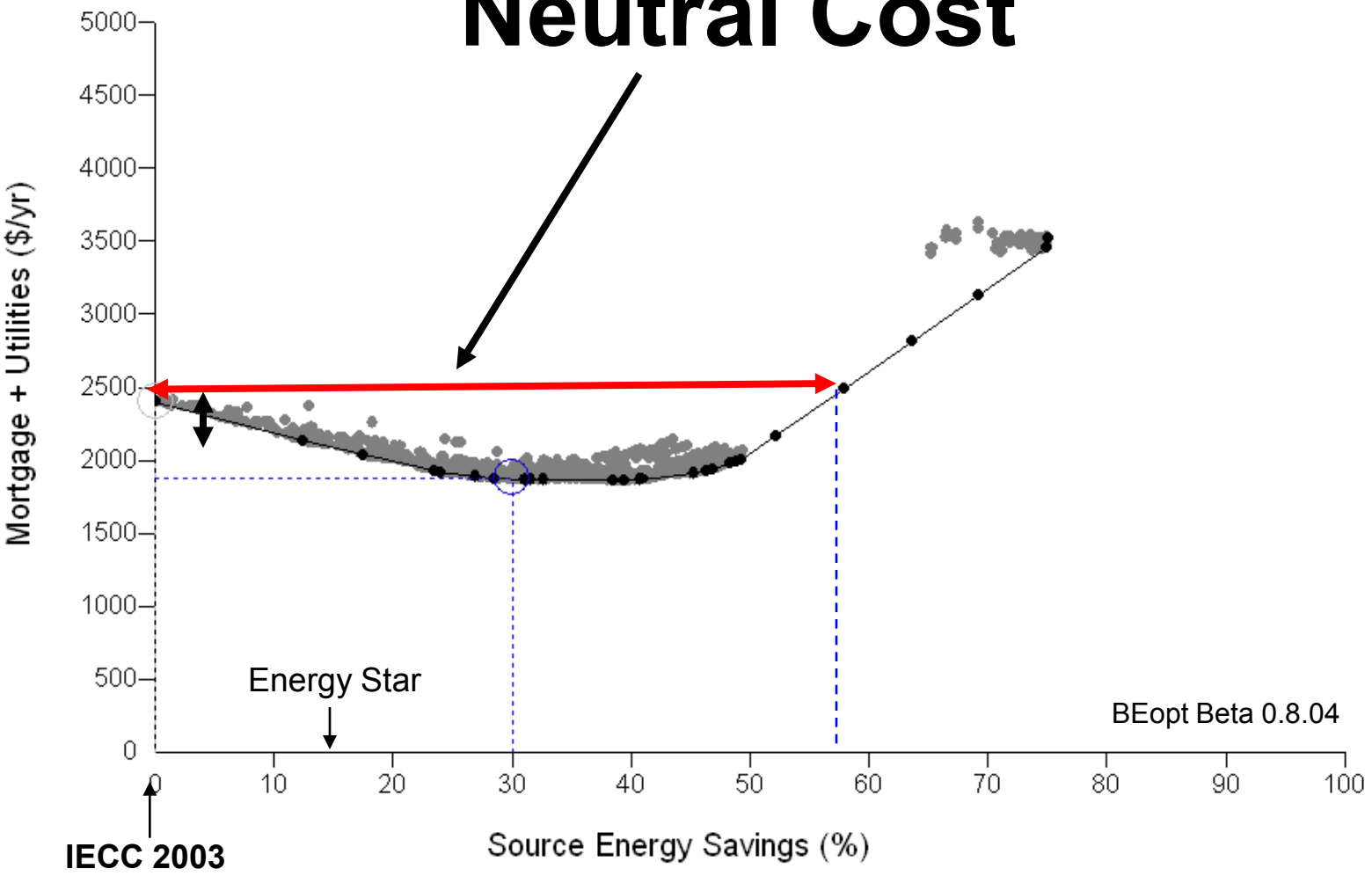
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Key Finding: There are Large Potential Energy Savings Near the Minimum Cost Point



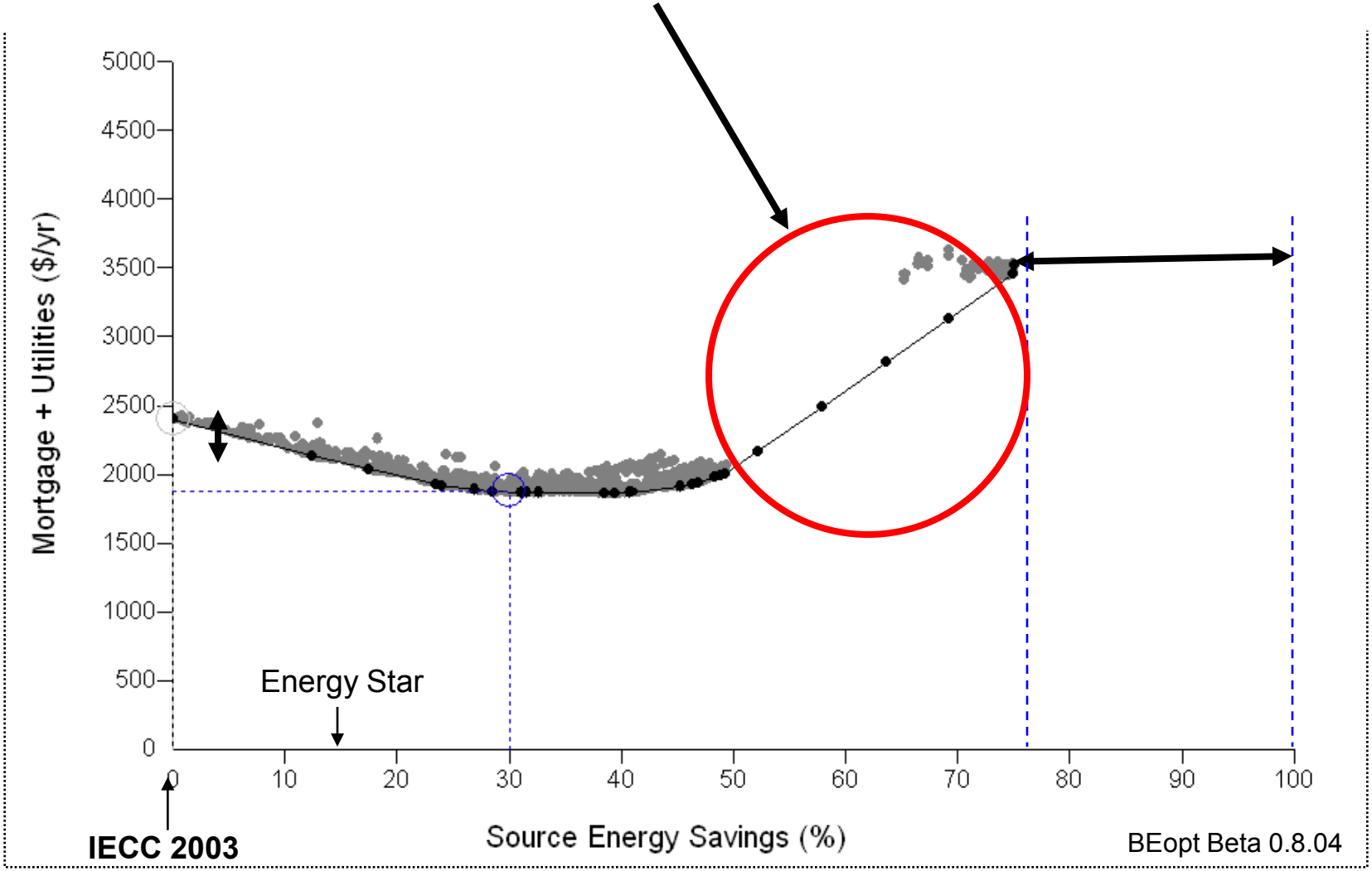
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Key Finding: There are Huge Potential Energy Savings at Neutral Cost



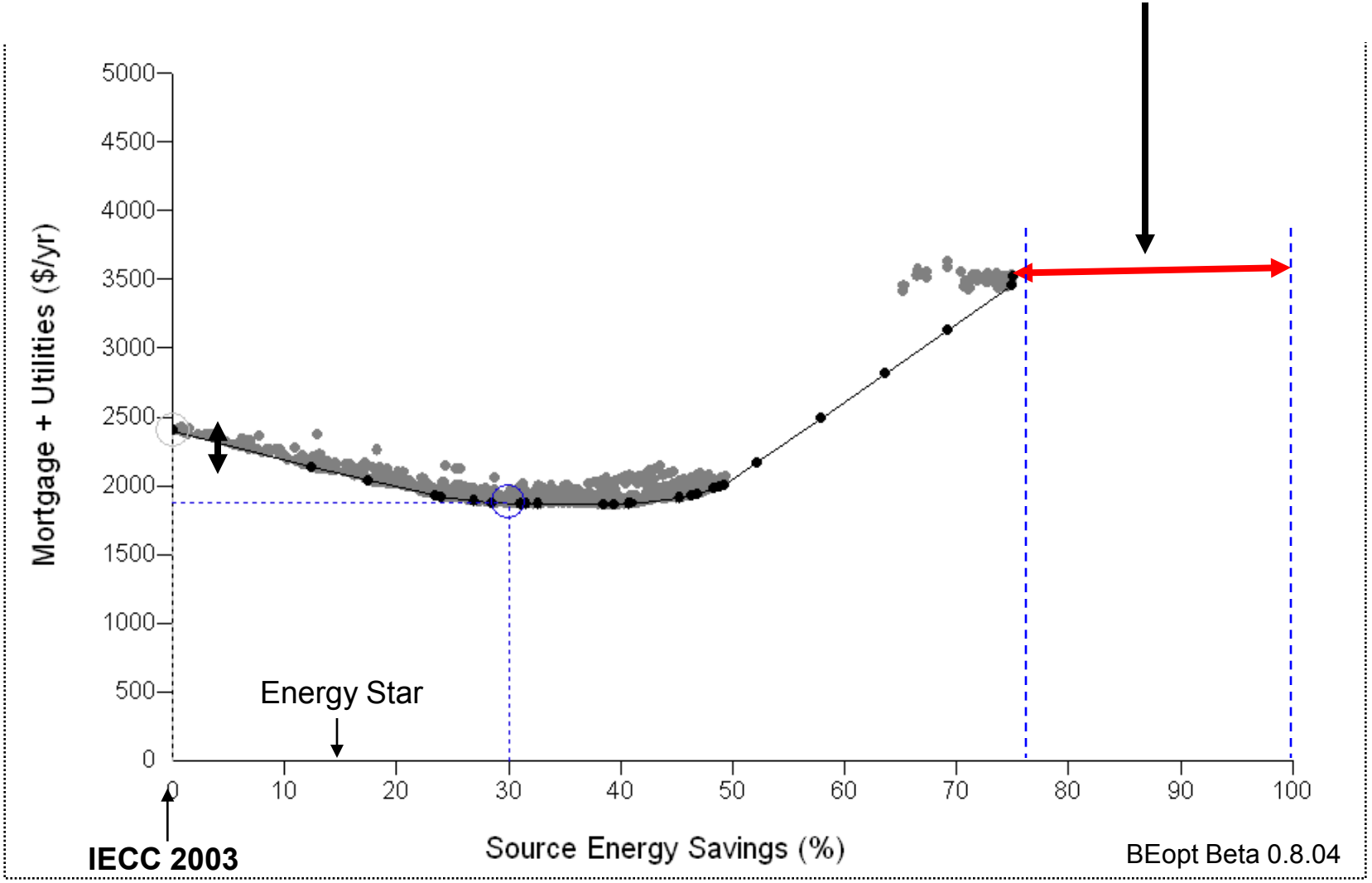
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Key Finding: Onsite Renewables Play a Key Supporting Role!



(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Key Finding: There is a 20%-30% Technology Gap to Achieve Net ZEH



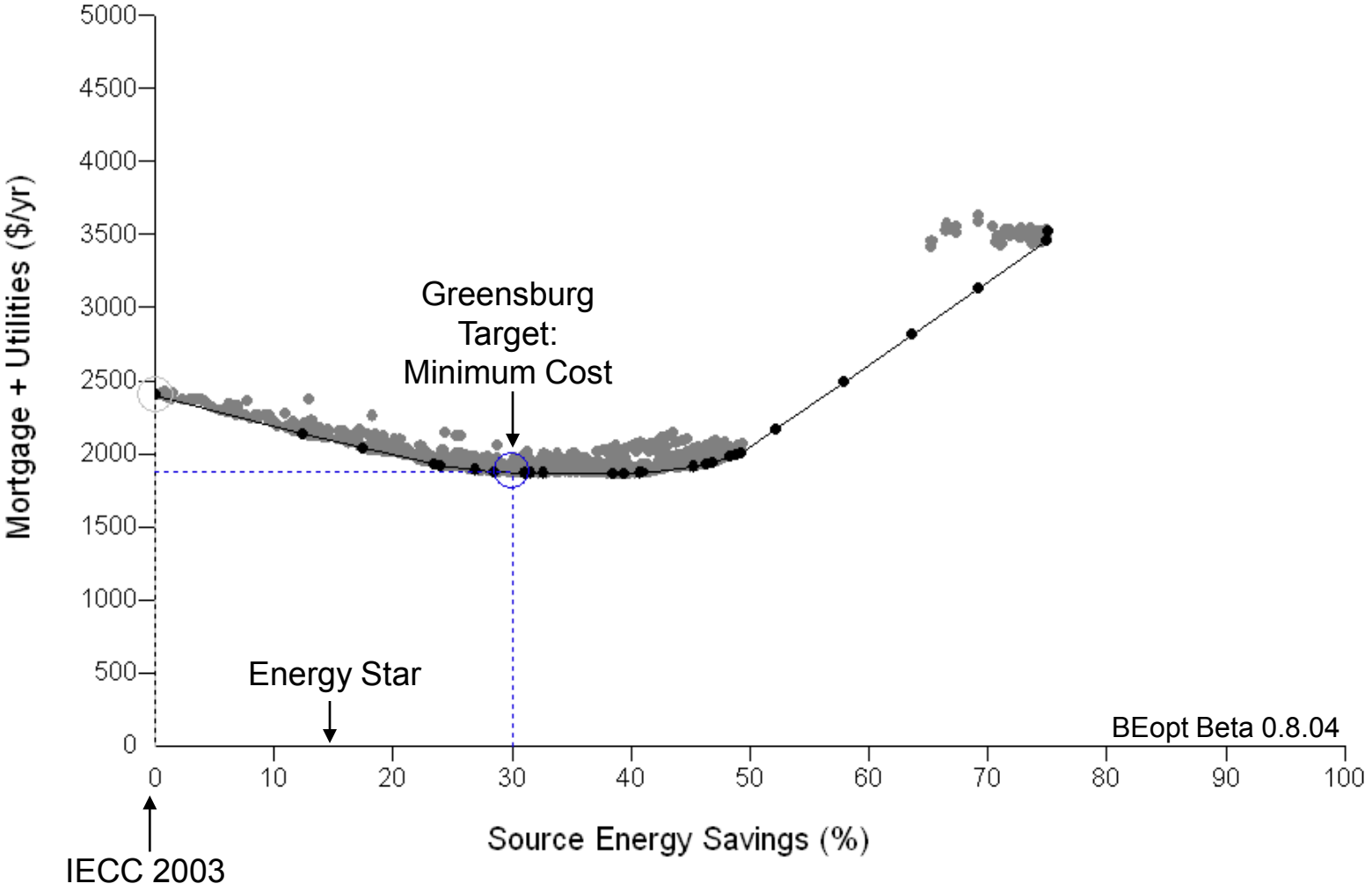
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Critical ZEH Technology Gaps

- High R Wall Systems: Durable high R wall systems for cold, northern marine, and mixed climates, leading to development of an R-30 wall assembly with an *incremental cost of $2/ft2-floor area* relative to an R-19 2x6 wall.
- Cold Climate DHW: DHW system with *$2000 incremental system cost* and 30% reduction in annual energy relative to a gas tankless hot water system with EF=0.8.
- Cold Climate R10 Window Assembly: R10 window assembly with a minimum SHGC of 0.3 and cost of $20/ft2 (*incremental cost of $4/ft2 of window area relative to current low e*)
- Very High Performance AC[1]: AC system with 30% reduction in annual energy use and *an incremental cost increase of $1000* relative to a current SEER 18/EER 13.4 system with tight ducts in conditioned space.
- MELs Reduction: 30% reduction in miscellaneous electric energy use with an *incremental cost of $1000*.

[1] The AC performance goal is an overall system performance goal and includes savings from efficiency (improvements in COP), zoning, night cooling, evaporative cooling, heat recovery, and capacity modulation.

30% Savings Target: Greensburg



(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

Example: Greensburg 30% Efficiency Package[1]

- 2x6 + R-19 batts (R14 wall assembly)
- R40 ceiling assembly
- R10 basement
- .0002 SLA (4 ACH_{50})
- Low e/low SHGC glazing (0.3 U-value, 0.37 SHGC)
- 50% CFL Lighting
- SEER 14 AC
- AFUE 90+ furnace
- Premium gas hot water, EF 0.61
- Tight ducts (Mastic, 5% Leakage), R-8
- BA QA (moisture control, …)

Estimated cost increase relative to standard home[2,3]: +$1.25-$2.00/ft2

Notes:
1. Equivalent packages may be substituted, based on specific builder preferences
2. Does not include costs associated with builder/contractor training and changes in business practices.
3. Incremental costs evaluated relative to minimum IECC 2003

Estimated Annual Cost Savings: 30% Energy Savings Target

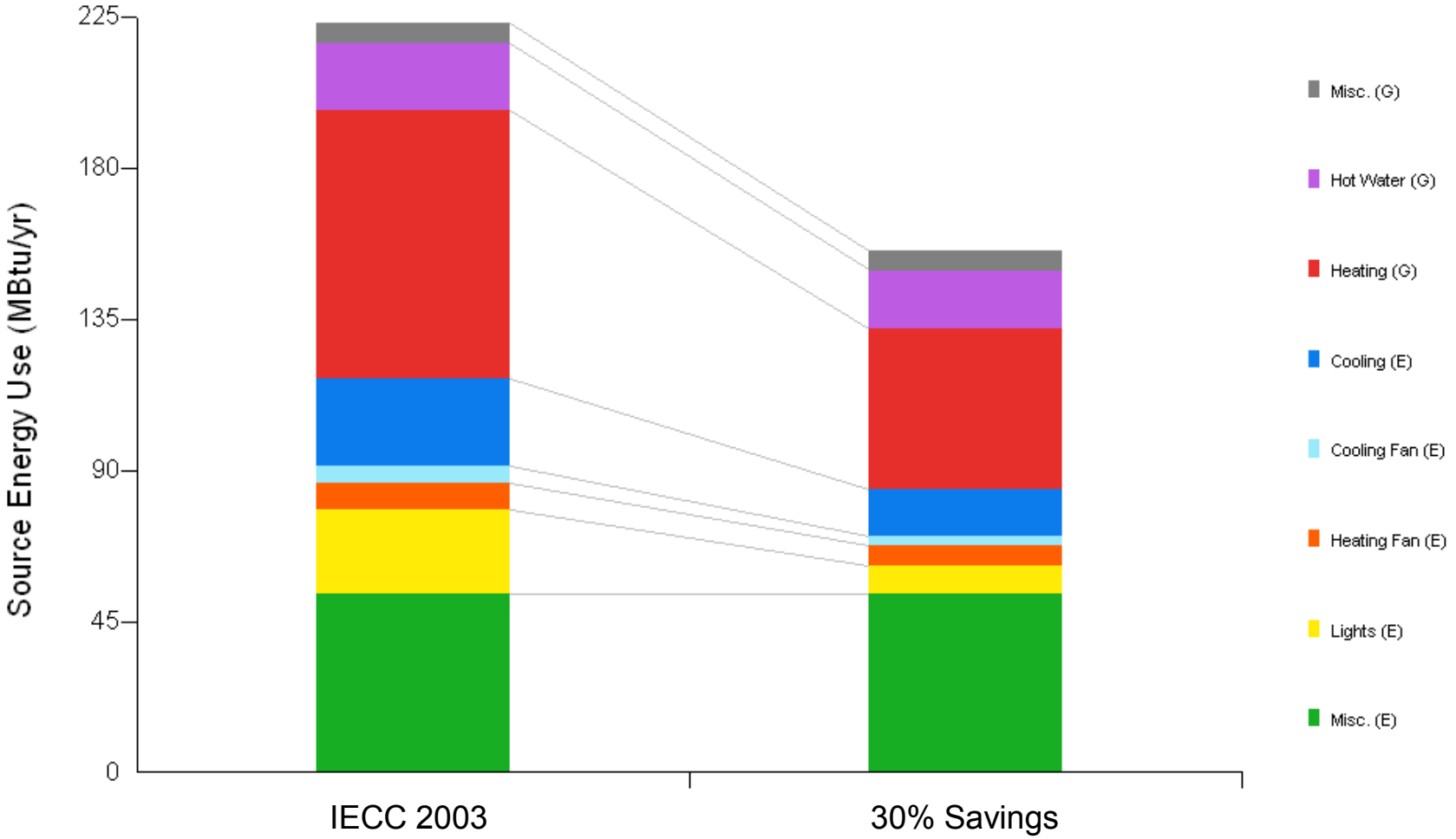
	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1]	$4,000
Annual Amortized Cost 7%, 30Year mortgage[2]	$211
Estimated Annual Utility Bill Savings	$723
Net Annual Savings	**$512**

(2000 ft2, 2-story, 16% window to floor area ratio, unconditioned basement)

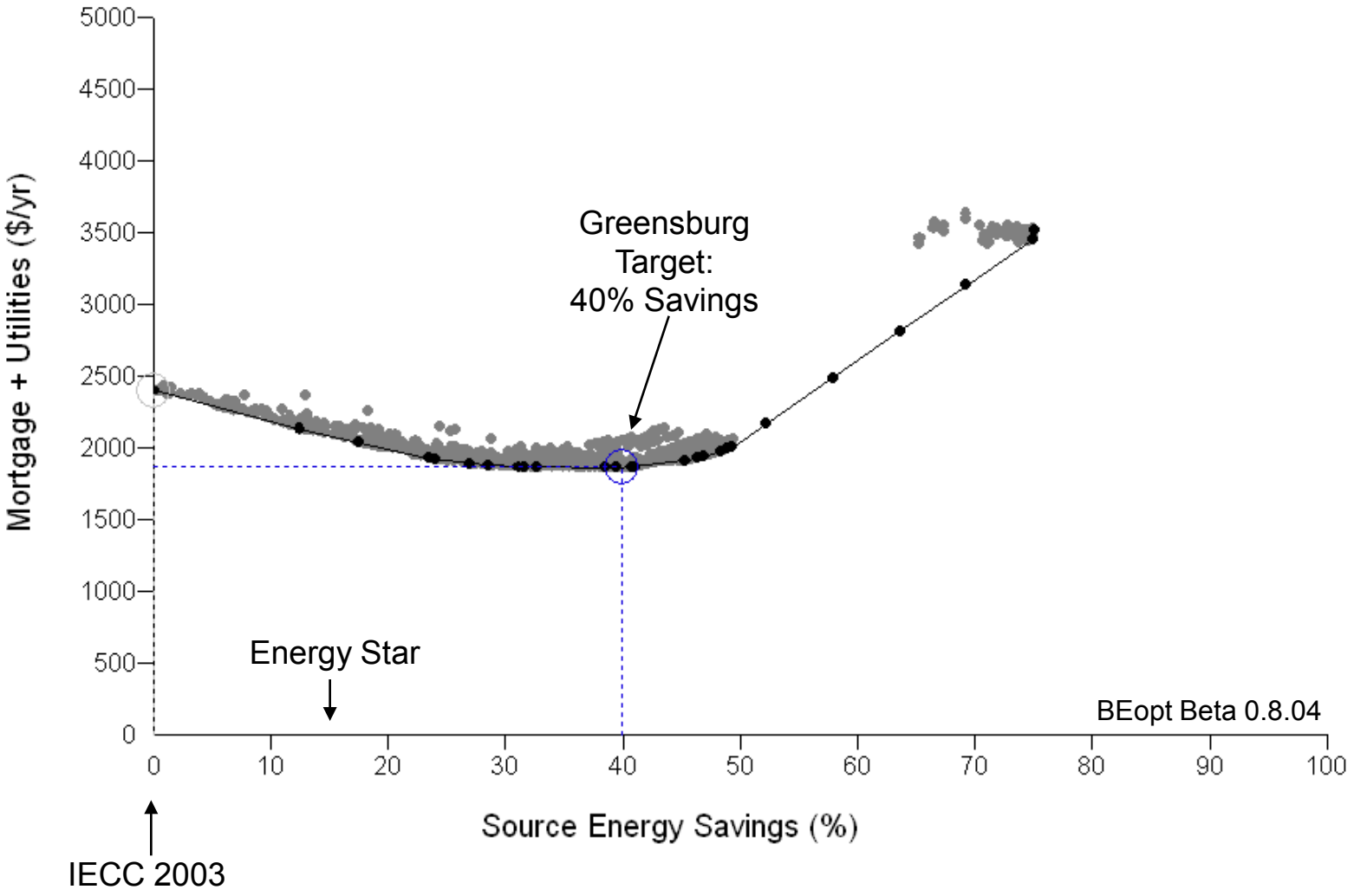
[1]Evaluated relative to minimum IECC 2003

[2] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use: 30% Target



40% Savings Target: Greensburg



(2000 ft2, 2-story, 16% window to floor area ratio, unconditioned basement)

Example: Greensburg 40% Efficiency Package[1]

- 2x6 + R-21 batts (R15 wall assembly)
- R50 ceiling assembly
- R10 basement
- .0002 SLA (4 ACH_{50})
- Low e/low SHGC glazing, Argon Fill (0.28 U-value, 0.37 SHGC)
- 80% CFL Lighting
- SEER 18 AC
- AFUE 90+ furnace
- Premium gas hot water, EF 0.61
- Tight ducts (Mastic, 5% Leakage), R-8
- BA QA (moisture control, …)

Estimated cost increase relative to standard home[2,3]: +$3.00-$4.00/ft2

Notes:
1. Equivalent packages may be substituted, based on specific builder preferences
2. Does not include costs associated with builder/contractor training and changes in business practices.
3. Incremental costs evaluated relative to minimum IECC 2003

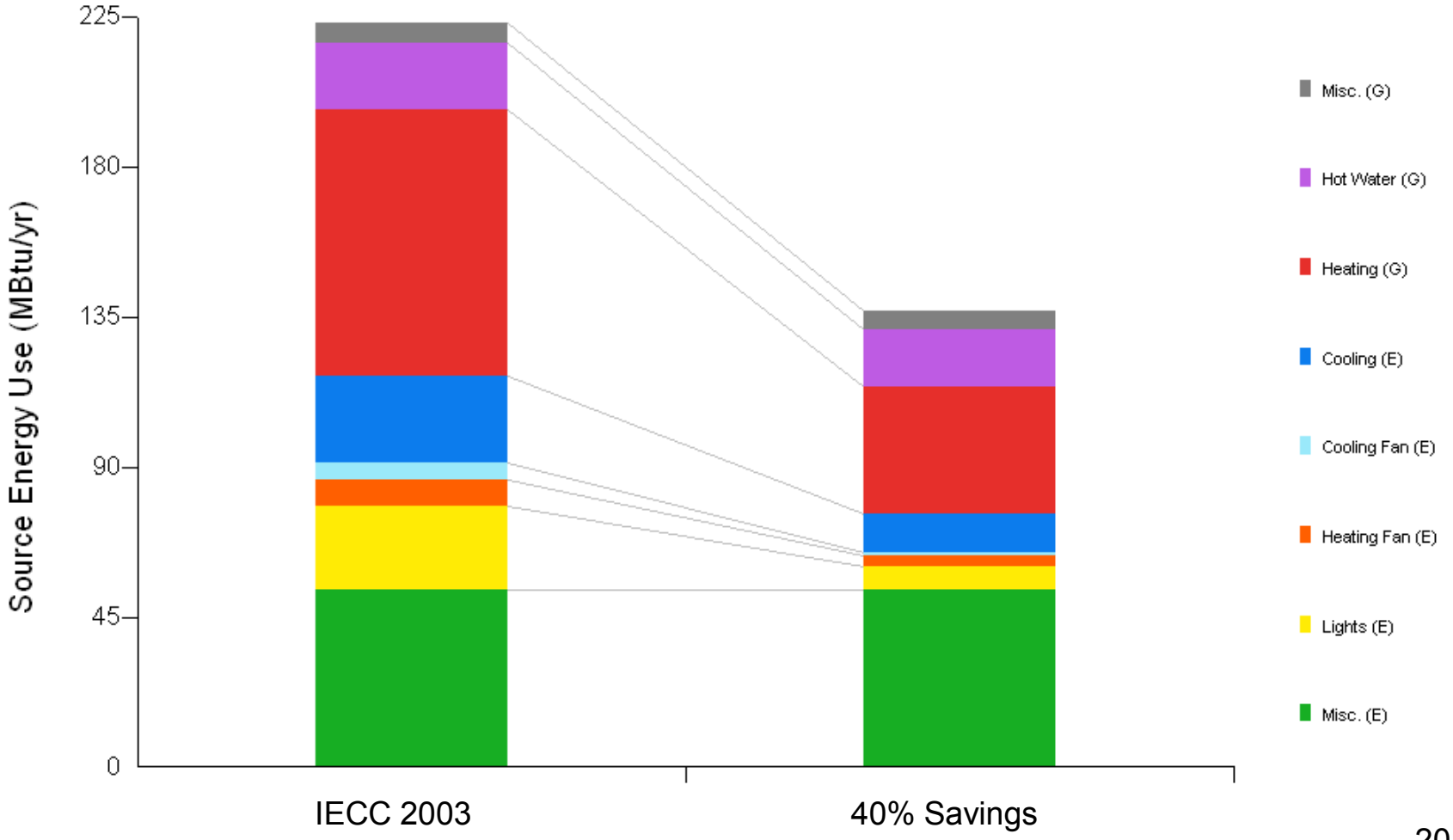
Estimated Annual Costs: 40% Efficiency Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$7,000
Annual Amortized Cost 7%, 30 Year mortgage[3]	$411
Annual Utility Bill Savings	$919
Net Annual Savings	**$508**

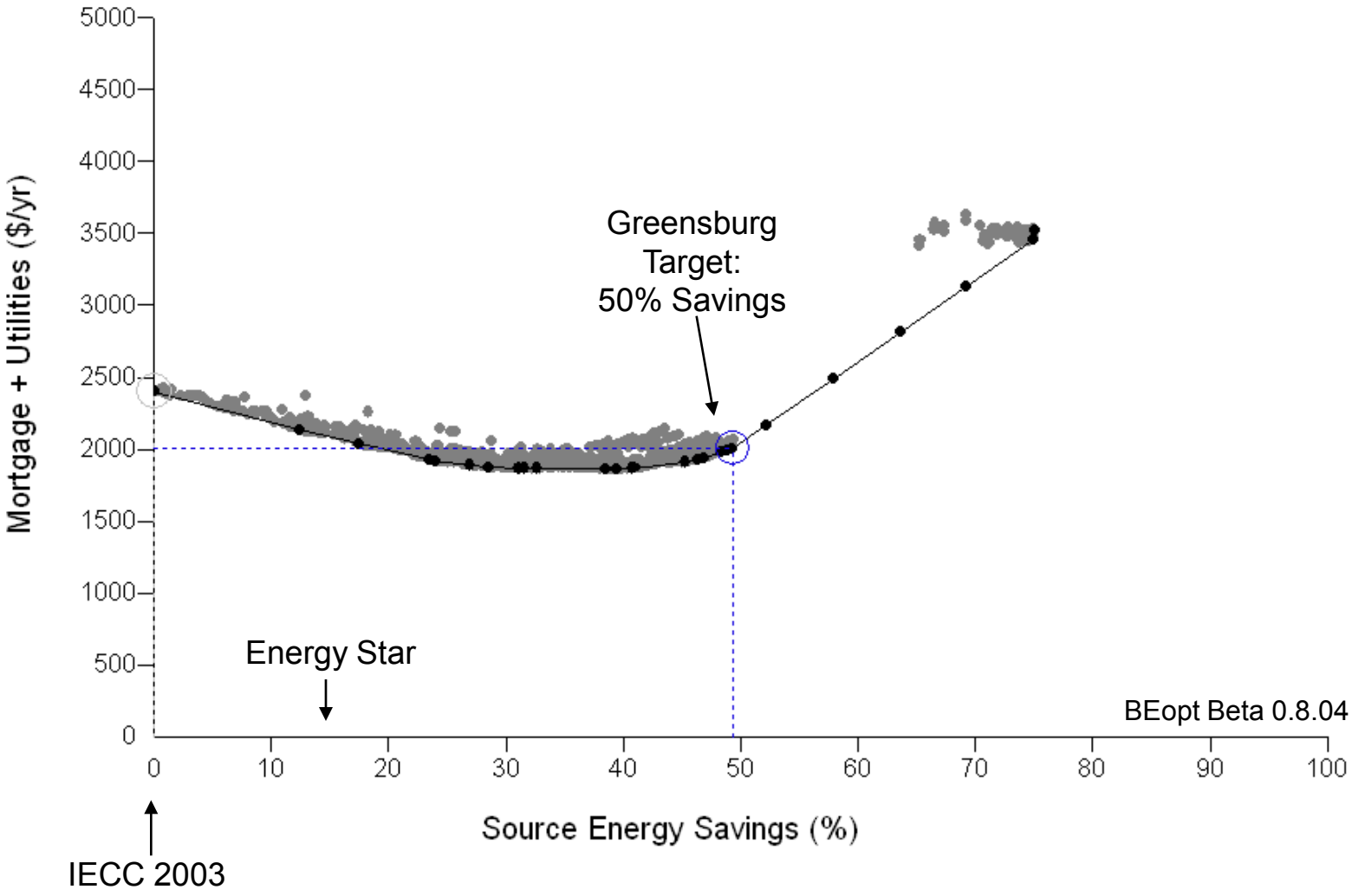
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

[1]Evaluated relative to minimum IECC 2003. Cost does not include impact of $2000 tax credit.
[2]Qualifies for federal new home tax credit
[3] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use: 40% Target



50% Savings Target: Greensburg



Example: Greensburg 50% Efficiency Package[1]

- 2x6 + R-19 batts+ foam sheathing (R22 wall assembly)
- R50 ceiling assembly
- R10 basement
- .0001 SLA (2 ACH_{50})
- Low e/low SHGC glazing, Argon Fill (0.28 U-value, 0.37 SHGC)
- 80% CFL Lighting
- SEER 18 AC
- AFUE 90+ furnace
- Gas tankless hot water, EF 0.8+
- Tight ducts (Mastic, 5% Leakage), in conditioned space
- Energy Star Appliances
- BA QA (moisture control, …)

Estimated cost increase relative to standard home[2,3]: +$6.00-$8.00/ft2

Notes:

1. Equivalent packages may be substituted, based on specific builder preferences
2. Does not include costs associated with builder/contractor training and changes in business practices.
3. Incremental costs evaluated relative to minimum IECC 2003

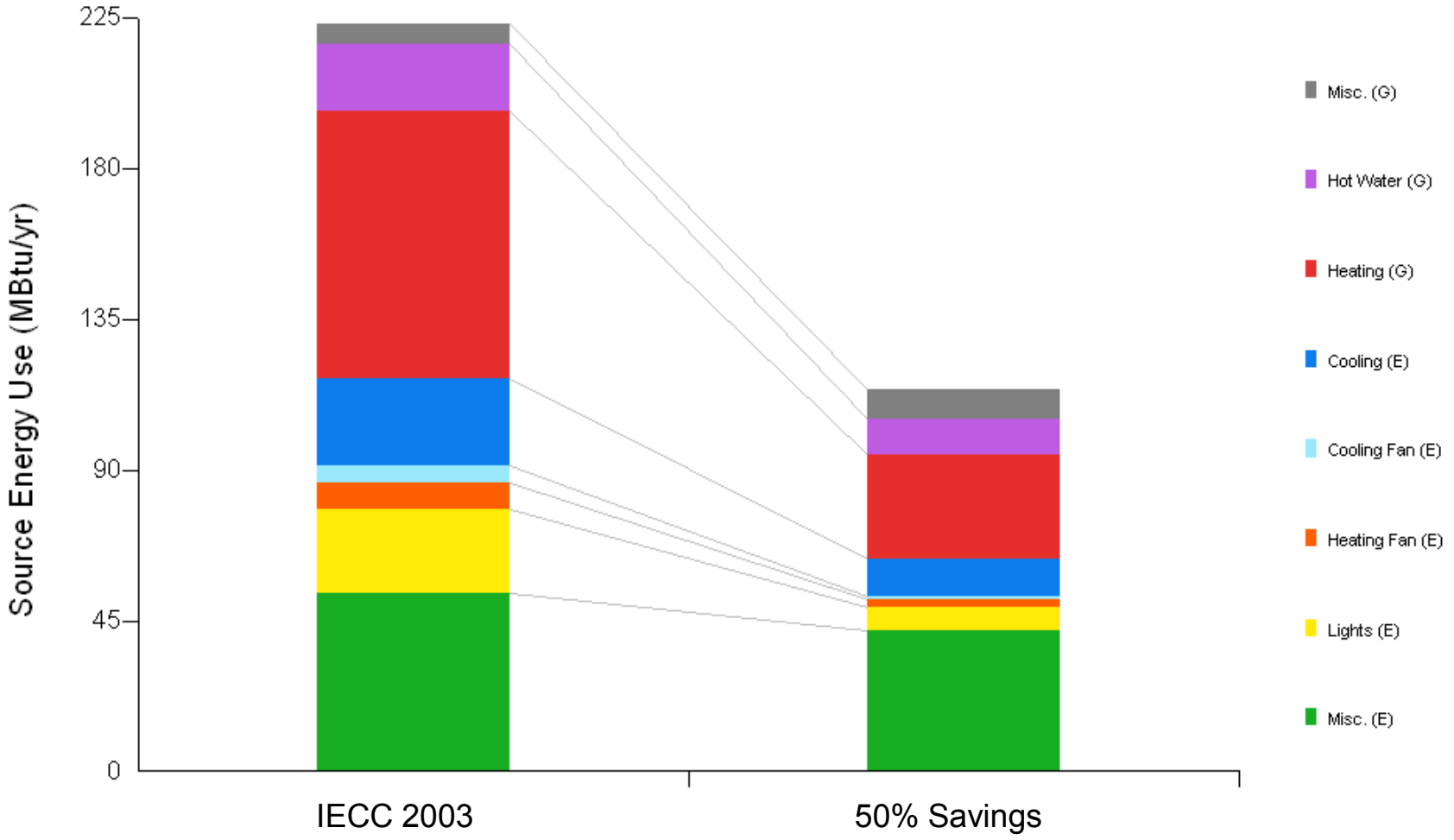
Estimated Annual Costs: 50% Efficiency Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$13,000
Annual Amortized Cost 7%, 30Year mortgage[3]	$706
Annual Utility Bill Savings	$1162
Net Annual Savings	**$456**

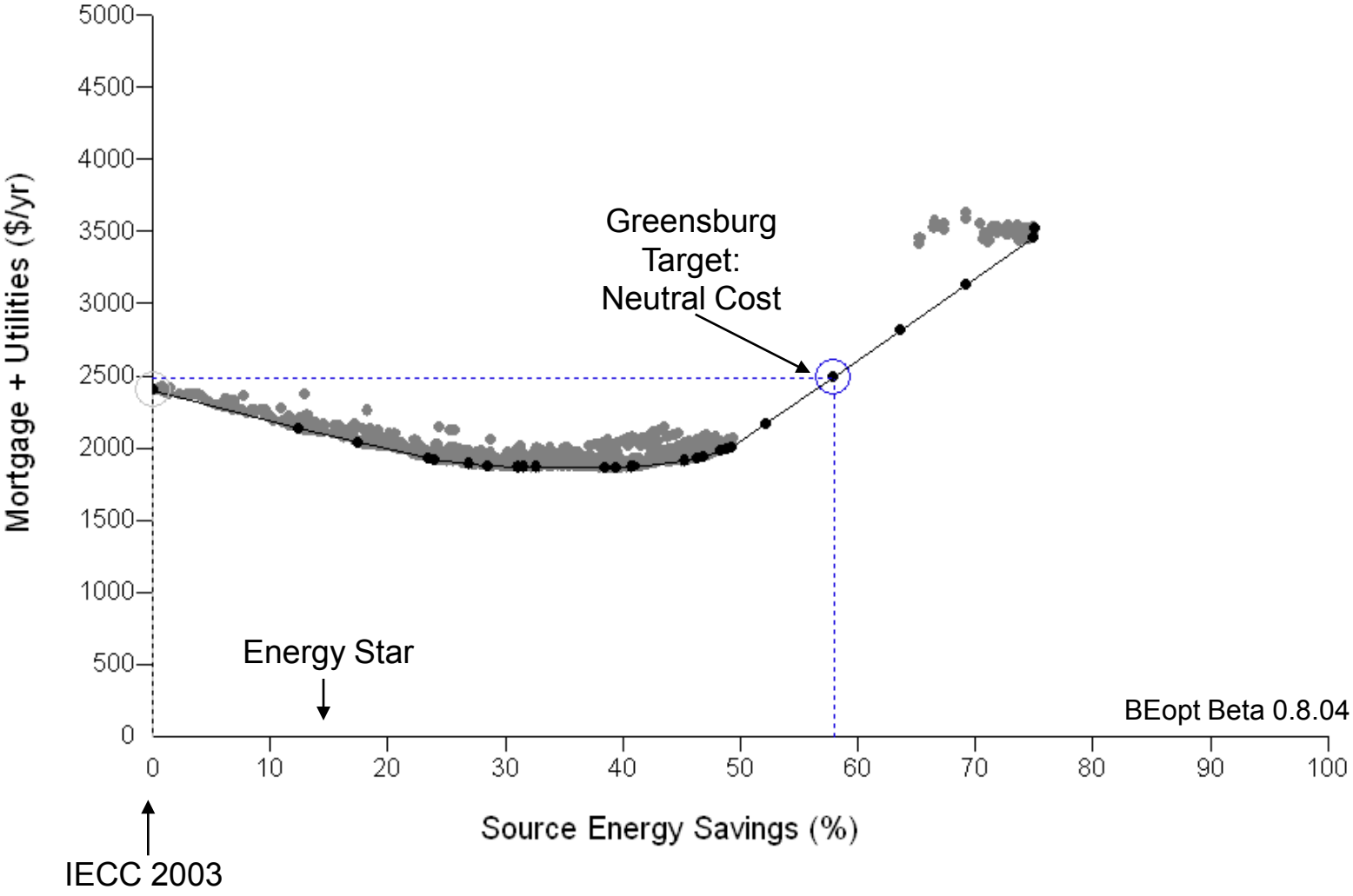
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

[1]Evaluated relative to minimum IECC 2003
[2]Qualifies for federal new home tax credit
[3] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use: 50% Target



Neutral Cost Point: Greensburg



Example: Greensburg Neutral Cost Package[1]

- R22 wall assembly (2x6 + R-19 batts+ foam sheathing)
- R50 ceiling assembly
- R10 basement
- .0001 SLA (2 ACH_{50})
- Low e/low SHGC glazing, Argon Fill (0.28 U-value, 0.37 SHGC)
- 80% CFL Lighting
- SEER 18 AC
- AFUE 90+ furnace
- Gas tankless hot water, EF 0.8+
- Tight ducts (Mastic, 5% Leakage), in conditioned space
- Energy Star Appliances
- 1.5 kW_{DC} PV System
- BA QA (moisture control, …)

Estimated cost increase relative to standard home[2,3]: +$10.00-$13.00/ft2

Notes:
1. Equivalent packages may be substituted, based on specific builder preferences
2. Does not include costs associated with builder/contractor training and changes in business practices.
3. Incremental costs evaluated relative to minimum IECC 2003

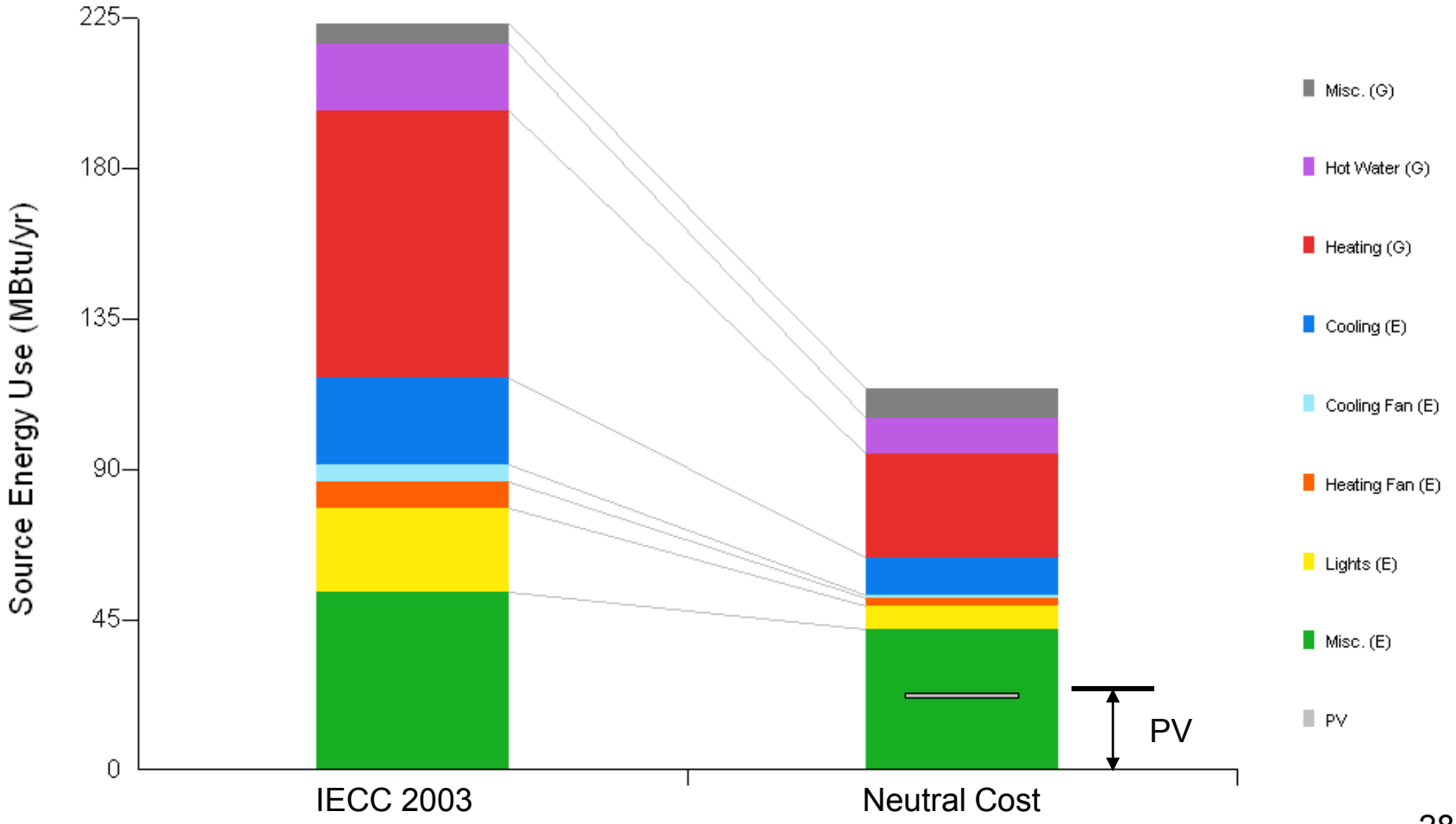
Estimated Annual Costs: Neutral Cost Target

	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$25,000
Annual Amortized Cost 7%, 30Year mortgage[3]	$1386
Annual Utility Bill Savings	$1386
Net Annual Savings	**$0**

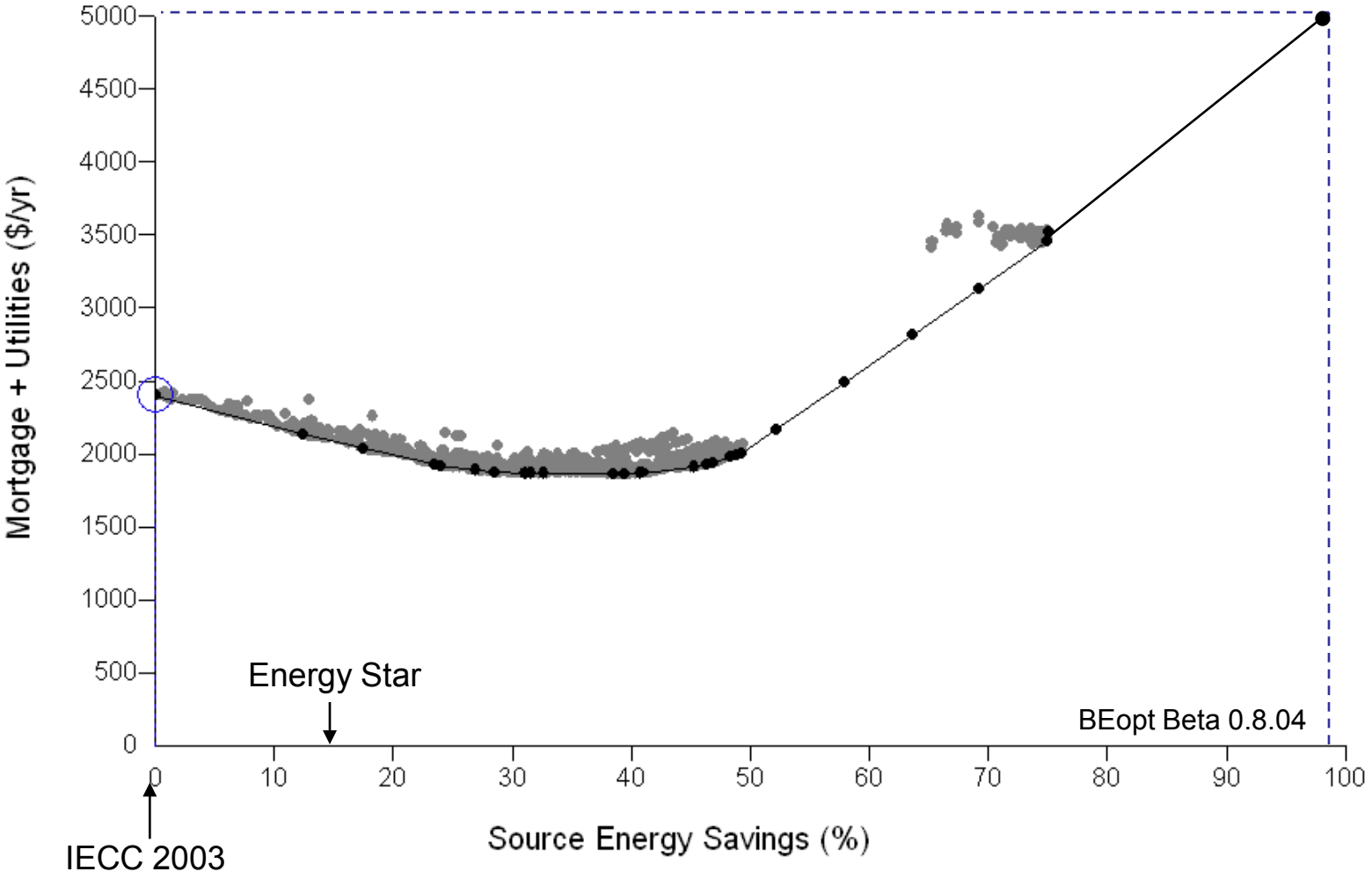
(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

[1]Evaluated relative to minimum IECC 2003
[2]Qualifies for federal new home tax credit
[3] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use: Neutral Cost Target



Net Zero Energy Target: Greensburg



(2000 ft2, 2-story, 16% window to floor area ratio, unconditioned basement)

Example: Greensburg NZEH Package[1]

- R22 wall assembly (2x6 + R-19 batts+ foam sheathing)
- R50 ceiling assembly
- R10 basement
- .0001 SLA (2 ACH_{50})
- Low e/low SHGC glazing, Argon Fill (0.28 U-value, 0.37 SHGC)
- 80% CFL Lighting
- SEER 18 AC
- AFUE 90+ furnace
- Gas tankless hot water, EF 0.8+
- Tight ducts (Mastic, 5% Leakage), in conditioned space
- Energy Star Appliances
- 7 kW_{DC} PV System and solar hot water system
- BA QA (moisture control, …)

Estimated cost increase relative to standard home[2,3]: +$35.00-$40.00/ft2

Notes:

1. Equivalent packages may be substituted, based on specific builder preferences
2. Does not include costs associated with builder/contractor training and changes in business practices.
3. Incremental costs evaluated relative to minimum IECC 2003

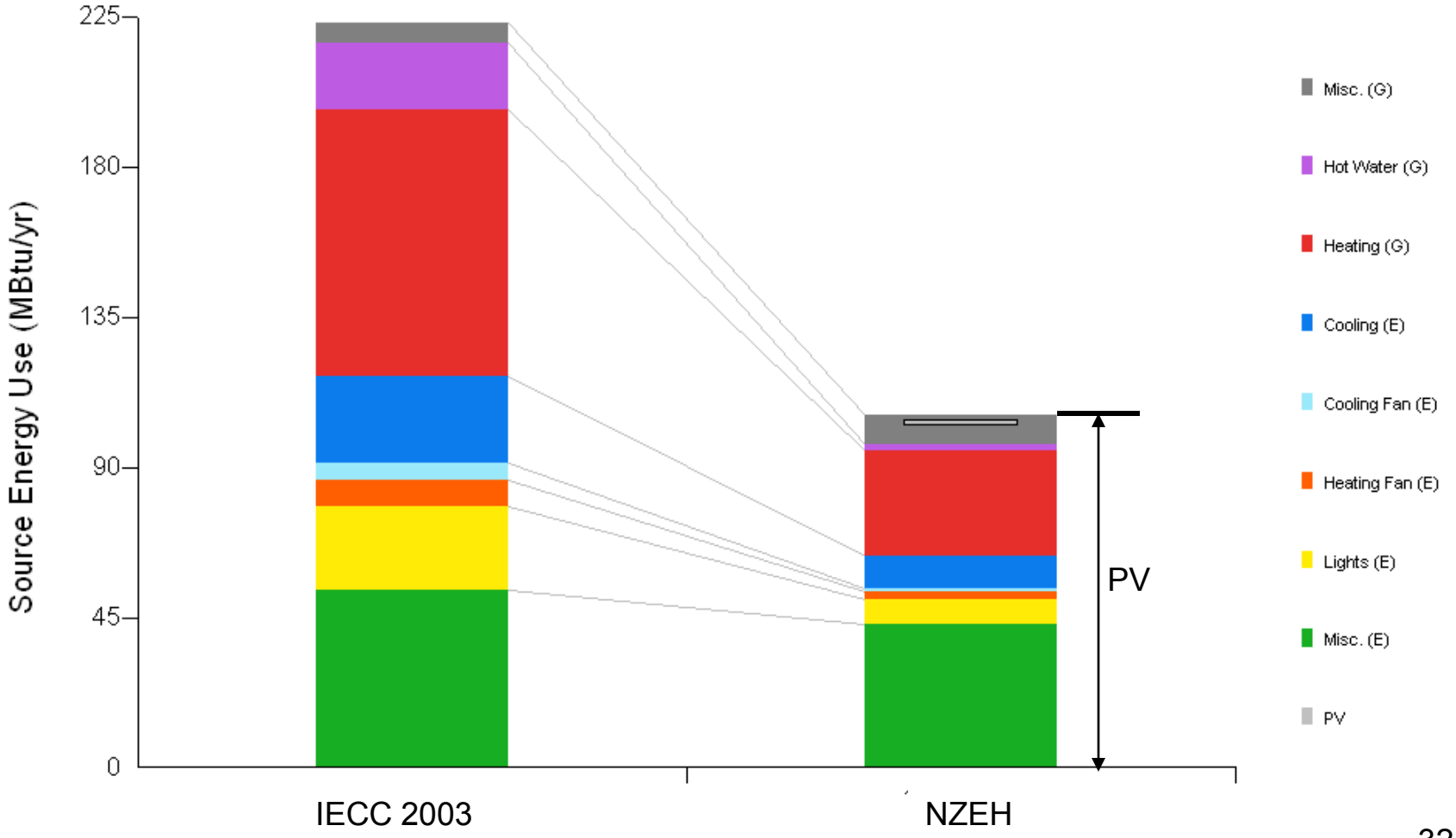
Estimated Annual Costs: Net Zero Energy Target

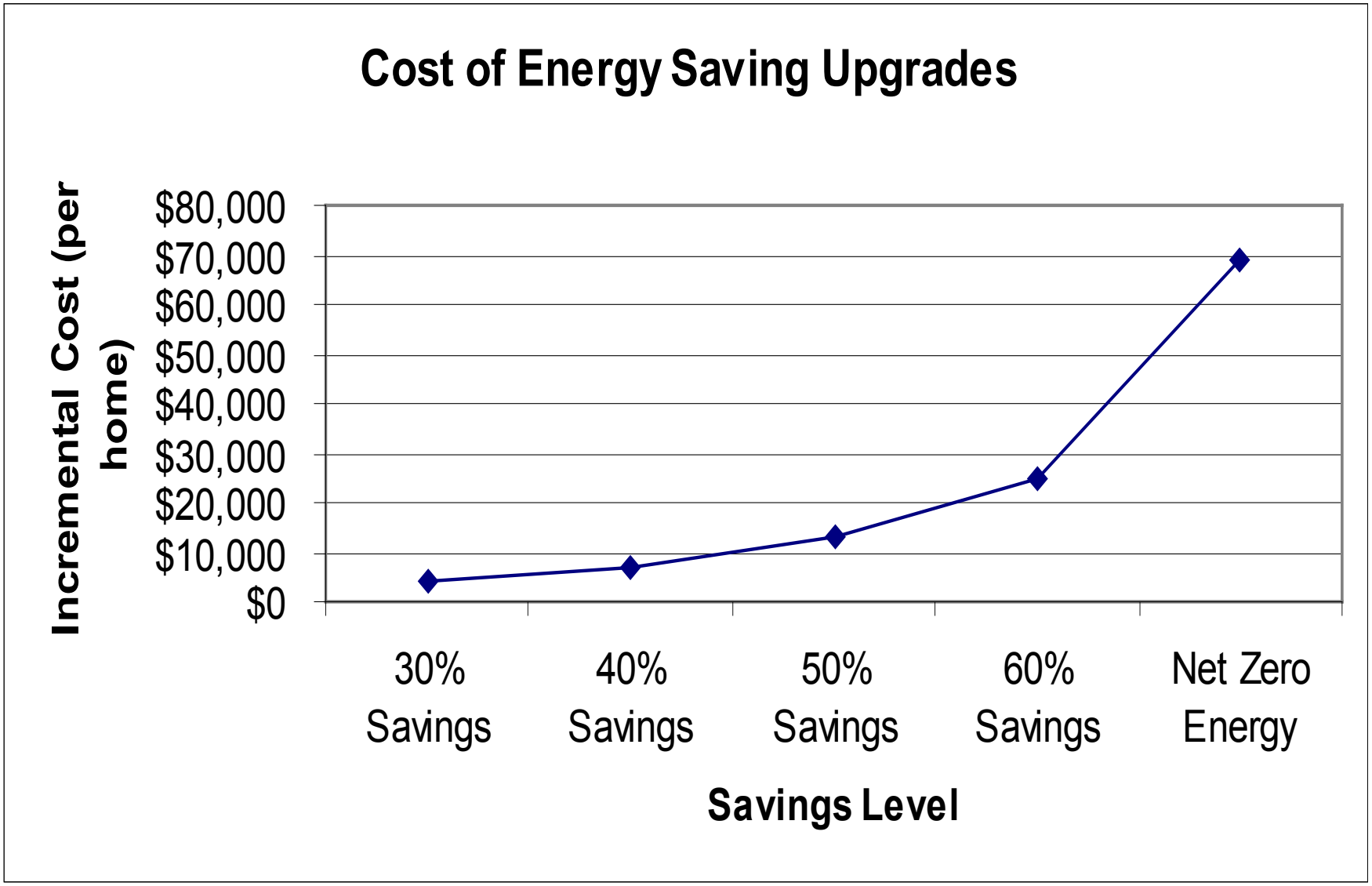
	Greensburg
Estimated Incremental First Cost Relative to Standard Practice[1,2]	$69,000
Annual Amortized Cost 7%, 30Year mortgage[2]	$4102
Annual Utility Bill Savings	$2306
Net Annual Savings	**-$1796**

(2000 ft2, 2-story, 16% window to floor area ratio), unconditioned basement

[1]Evaluated relative to minimum IECC 2003
[2]Qualifies for federal new home tax credit
[3] Assumes 28% marginal tax bracket and includes present value of future replacements of equipment over 30 year life of mortgage.

Estimated Annual Energy Savings by End Use: Net Zero Energy Target




Cost of Energy Saving Upgrades
Incremental Cost (per home)
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
30% Savings
40% Savings
50% Savings
60% Savings
Net Zero Energy
Savings Level